

Projected Applications of a “Weather in a Box” Computing System at the NASA Short-term Prediction Research and Transition (SPoRT) Center

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IN13A-1099

What is the NASA SPoRT Center?

❖ The NASA Short-term Prediction Research and Transition (SPoRT) Center partners with several universities and government agencies to:

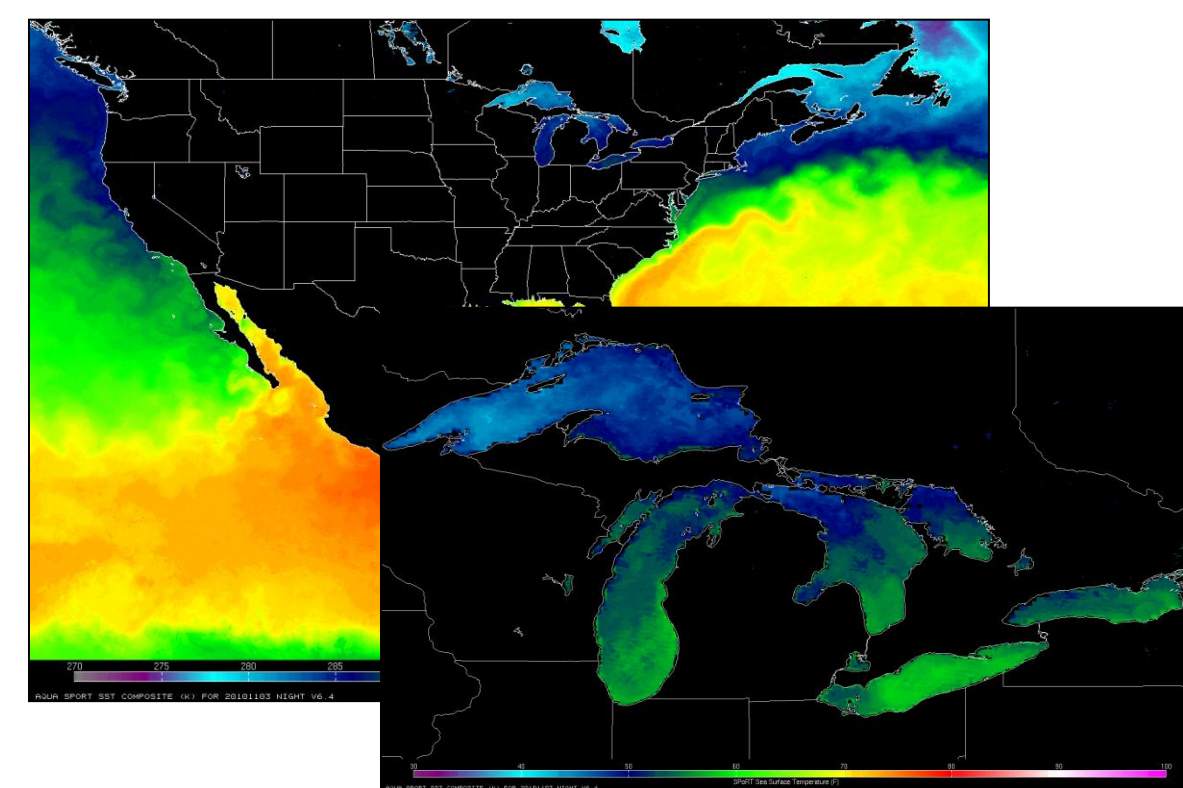
- Improve short-term (0-48 hr) weather forecasts
- Facilitate and promote the use of NASA Earth Observing System satellite data for weather analysis and forecasting
- Promote the use of unique, advanced NASA modeling and data assimilation techniques applicable to regional forecasting

Mission Statement

❖ Serve as a focal point and facilitator for the transfer of NASA Earth Science technologies to the operational weather community, emphasizing short-term forecasting.

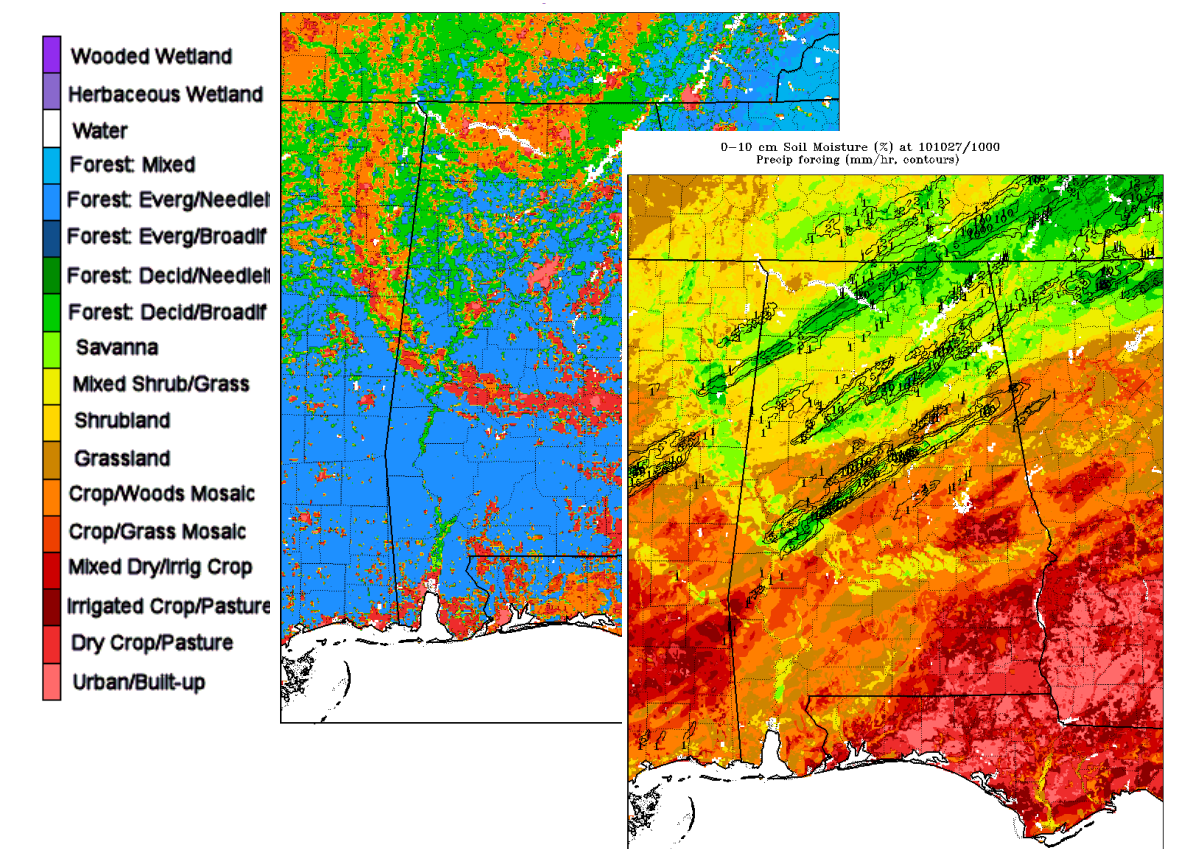
SPoRT Contributions to the Weather Research and Forecasting (WRF) Model

❖ SPoRT has developed several techniques and unique data products to support high resolution, short-term weather forecasts:



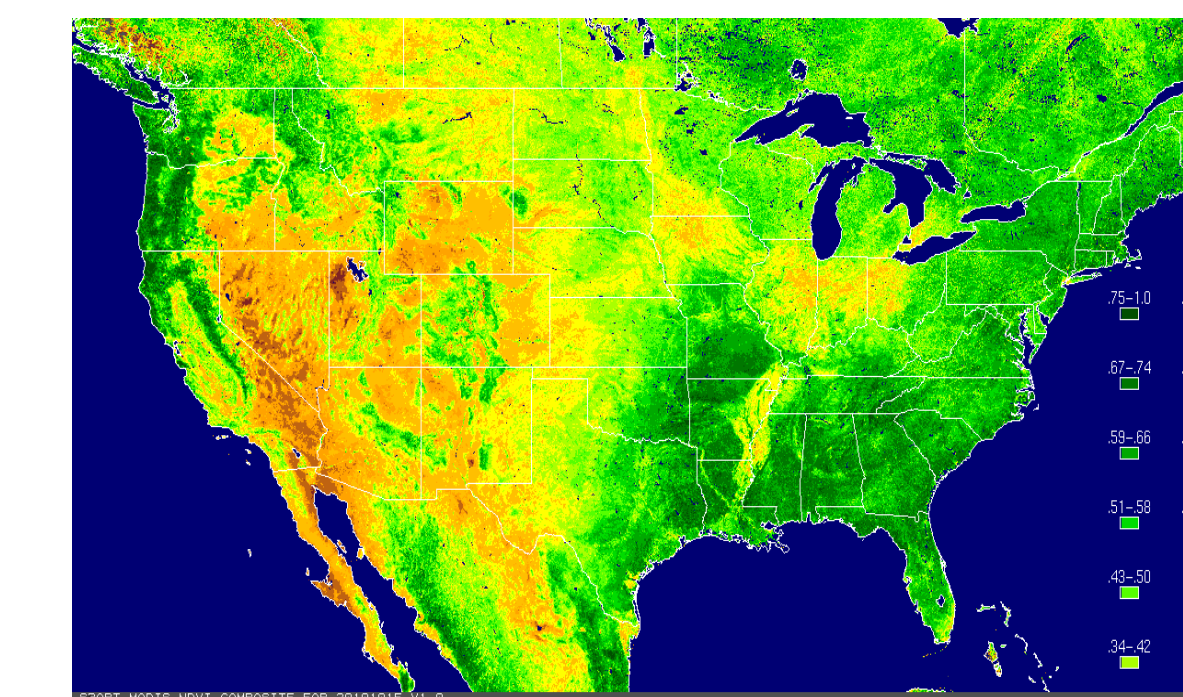
Sea and Lake Surface Temperature Composites

- ❖ Produced four times per day.
- ❖ 1 km spatial resolution
- ❖ Derived from MODIS/AMSR-E
- ❖ Incorporates sea and lake ice analyses to provide a physically consistent depiction of open water characteristics.



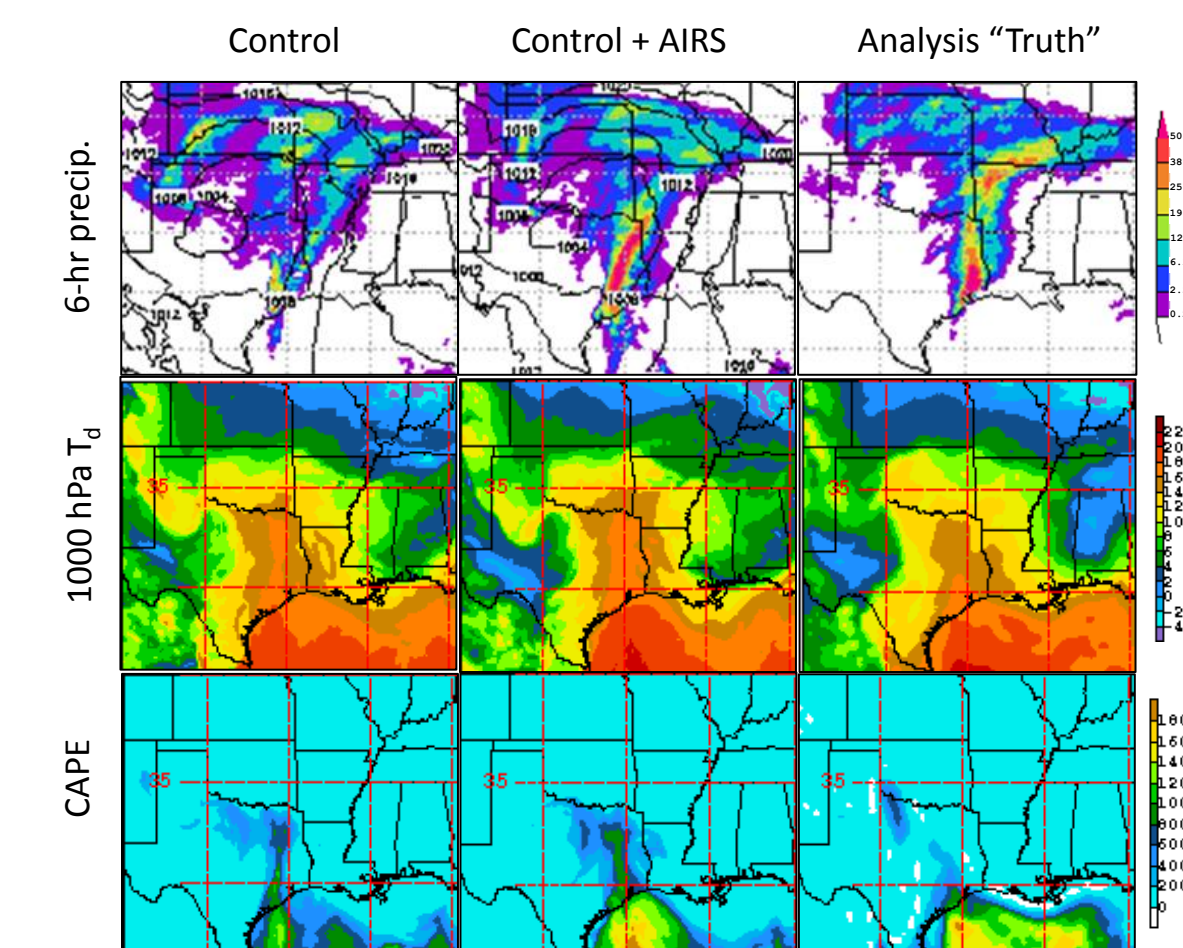
NASA Land Information System

- ❖ Unique NASA research tool
- ❖ 3 km spatial resolution
- ❖ Receives inputs of radar estimated precipitation and satellite vegetation composites.
- ❖ Outputs high resolution soil moisture, soil type, and vegetation characteristics.



Normalized Difference Vegetation Index (NDVI) Composites

- ❖ Daily composites at 1 km resolution, derived from MODIS, to serve as a proxy for vegetation cover and greenness fraction.
- ❖ Replaces coarse climatology fields in model forecasts.



Atmospheric Infrared Sounder (AIRS) Profile Assimilation

- ❖ Provides vertical profiles of temperature and moisture with horizontal resolution of 50 km.
- ❖ Supplements rawinsonde network with observations at asynoptic hours.
- ❖ Used in variational assimilation techniques to improve the three-dimensional atmospheric analysis.

SPoRT “Weather in a Box” Systems

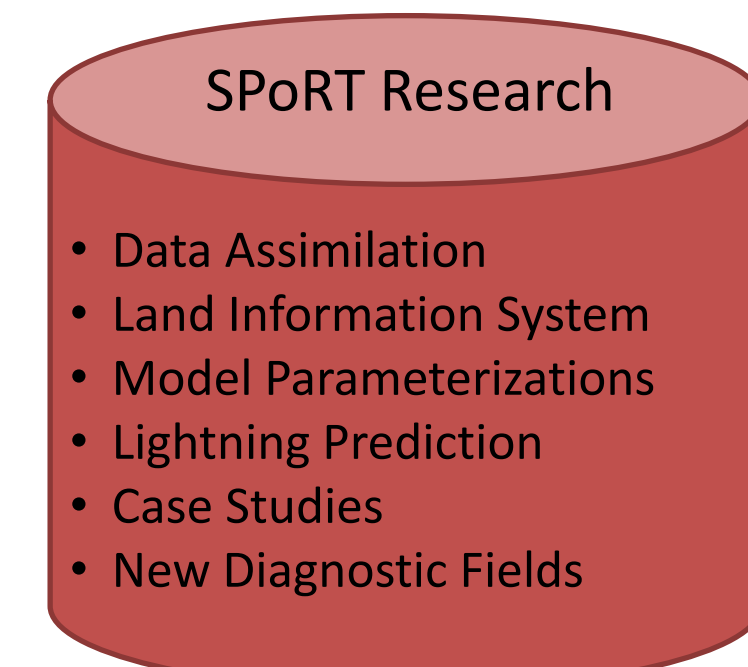
❖ SPoRT is acquiring two new modeling systems to support weather forecasting experiments utilizing unique NASA research tools and products:

Research and Development

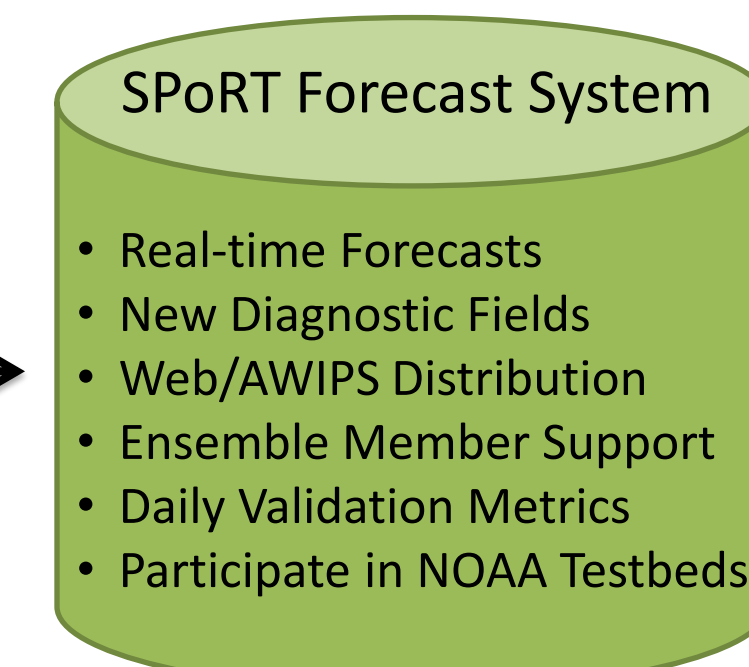
- CRAY CX1 Chassis
- 8 Compute Nodes
- Each node contains:
 - 8 Intel Xeon X5550 Cores
 - 2.67 GHz
 - 24 GB RAM
 - 320 GB 7.2k HDD
 - Infiniband connectivity

Real-Time Forecasting

- CRAY CX1 Chassis
- 8 Compute Nodes
- Each node contains:
 - 8 Intel Xeon X5472 Cores
 - 3.00 GHz
 - 32 GB RAM
 - 320 GB 7.2k HDD
 - Infiniband connectivity



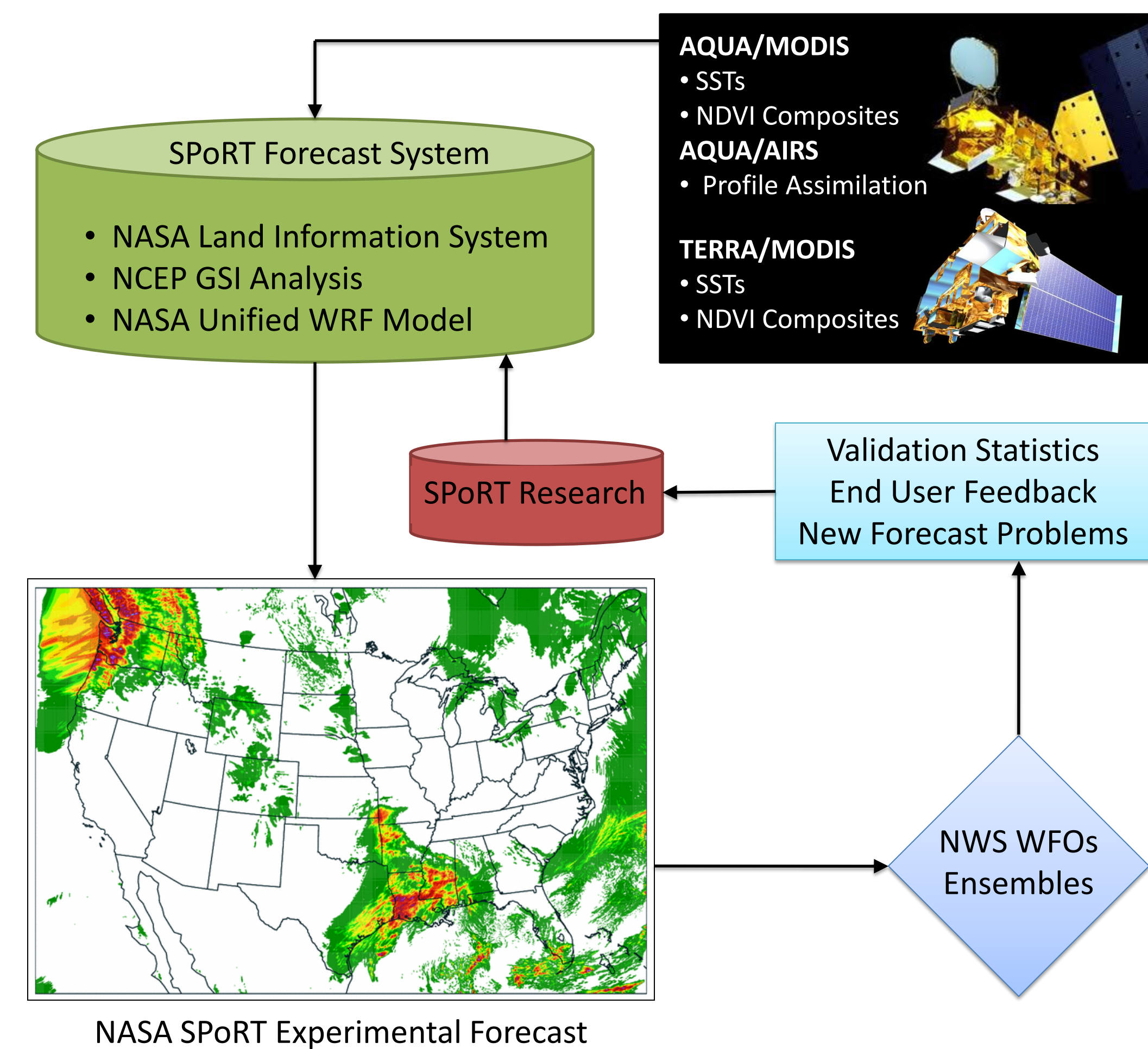
R&D



SPoRT “Weather in a Box” Software

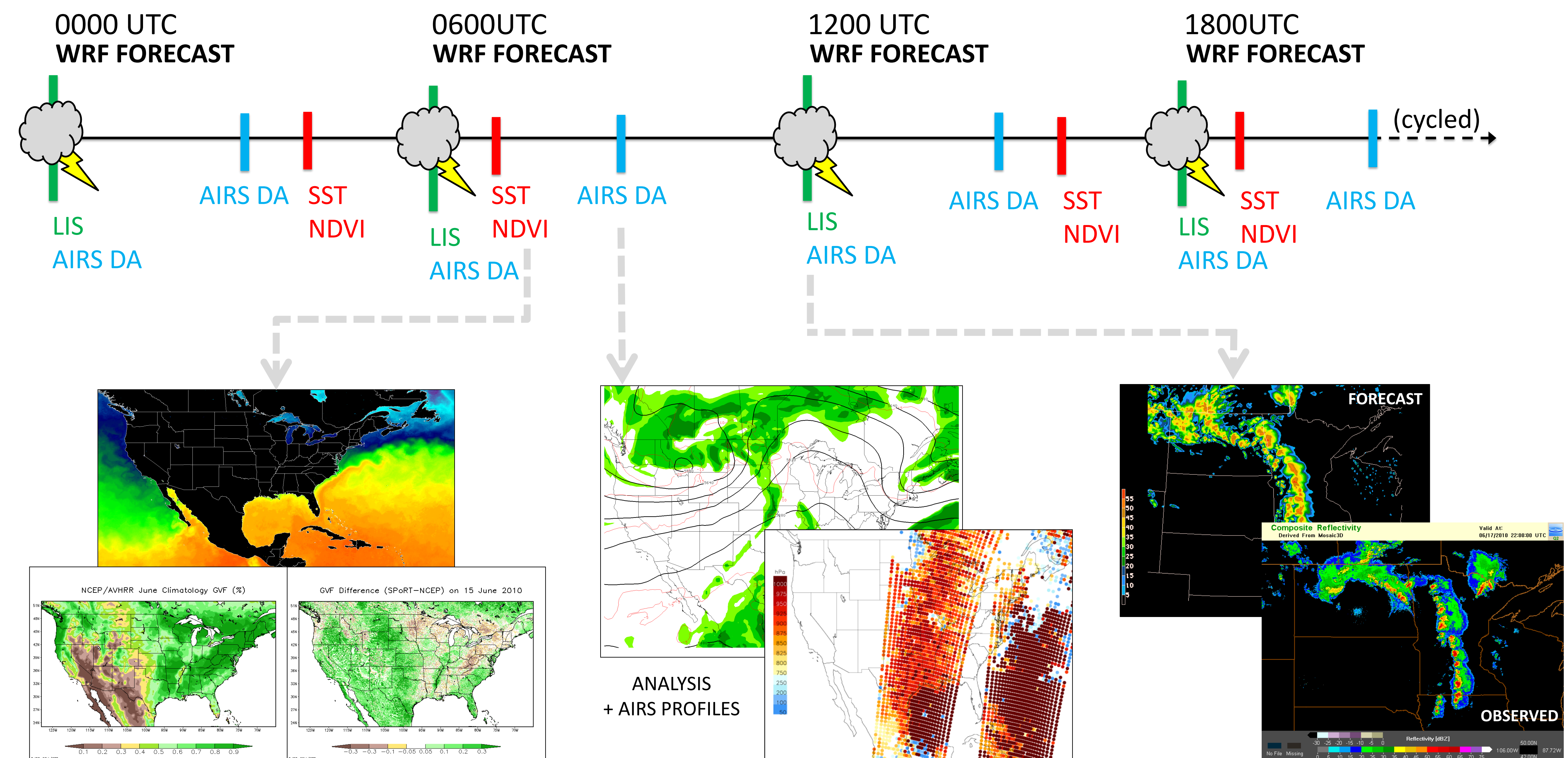
❖ High resolution forecasts will be generated using the NASA Unified Weather Research and Forecasting (NU-WRF) modeling suite, which includes:

- Advanced Research WRF (WRF-ARW)
- NASA Land Information System (LIS) with internal coupling
- NCAR Model Evaluation Tools (MET) Package
- Goddard Chemistry Aerosol Radiation and Transport (GOCART)
- Goddard Satellite Data Simulator Unit (SDSU)
- Unique diagnostic fields for severe weather forecasting
- Lightning forecasting capabilities based upon cloud microphysics
- WRF Pre- and Post-Processors



Hypothetical Forecast Cycle

Example Applications of Unique NASA/SPoRT Data



SSTs, Soil Moisture, and GVF

- ❖ High resolution, accurate surface water temperatures for coastal processes and moisture return.
- ❖ Soil moisture and greenness vegetation fractions derived from the NDVI to improve evapotranspiration and land contributions to low level moisture sources.

AIRS Profile Assimilation

- ❖ AIRS profiles contribute moisture and temperature data above cloud top to adjust model initial conditions.
- ❖ Above: Warm colors represent widespread, contribution of AIRS data in cloud-free conditions.
- ❖ Available on orbital times between the 00/12 UTC rawinsonde network.

NU-WRF Model Forecast

- ❖ Goal: Generate high resolution (4 km) forecasts that simulate precipitation and storm structure.
- ❖ Determine improvements gained through use of NASA data sets.
- ❖ Contribute our unique, NASA-driven forecast to ensemble efforts characterizing forecast uncertainty.

Summary

- ❖ SPoRT’s new “Weather in a Box” resources will provide weather research and forecast modeling capabilities for real-time application.
- ❖ Model output will provide additional forecast guidance and research into the impacts of new NASA satellite data sets and software capabilities.
- ❖ By combining several research tools and satellite products, SPoRT can generate model guidance that is strongly influenced by unique NASA contributions.

Acknowledgements

- ❖ SPoRT modeling clusters were provided by Dr. Tsengdar Lee, High End Computing Program Manager at NASA Headquarters.
- ❖ Software installation and configuration was performed by NASA Goddard Space Flight Center under the guidance of Tom Clune.
- ❖ Local software and installation support at NASA Marshall Space Flight Center was performed and managed by Rita Edwards and David Cross.